#8

JAPANESE PATENT OFFICE
PATENT JOURNAL (A)
KOKAI PATENT APPLICATION NO. HEI 9[1997]-34535

Int. Cl.[6]:	G 05 B 23/02 //G 06 F 17/60
Sequence No. for Office Use:	0360-3H
Filing No.:	Hei 7[1995]-177827
Filing Date:	July 13, 1995
Publication Date:	February 7, 1997
No. of Claims:	8 (Total of 14 pages; OL)
Examination Request:	Not filed

MAINTENANCE NOTIFICATION SYSTEM

Inventor: Owaru Kuramoto
Mitsubishi Electric Corp.
2-2-3 Marunouchi, Chiyoda-ku,
Tokyo

Applicant: 000006013
Mitsubishi Electric Corp.
2-2-3 Marunouchi, Chiyoda-ku,
Tokyo

Agent: Masuo Oiwa, patent attorney

[There are no amendments to this patent.]

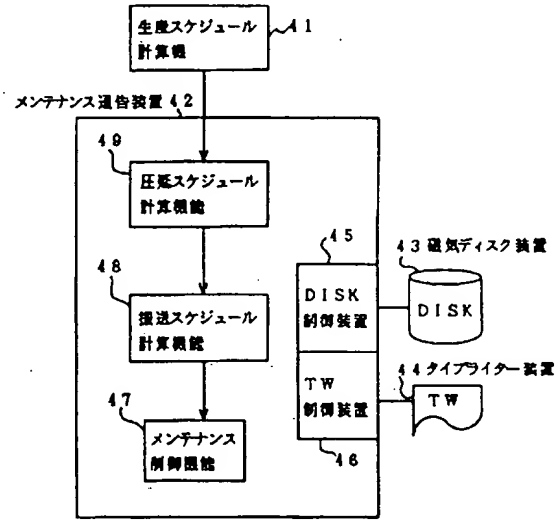
Abstract

Problem

The purpose of this invention is to more accurately predict which roll, machine, etc. on the rolling line will become the target of maintenance, and when the maintenance is to be performed.

Means to solve

In this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values for the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of the various machines, affiliated equipment, and consumables is reported beforehand.



Key:
41 Manufacturing schedule computer
42 Maintenance notification device
43 Magnetic tape device
44 Typewriter device
45 DISK controller
46 TW [typewriter] controller
47 Maintenance control function
48 Transport schedule computing function
49 Rolling schedule computing function

Claims

1. A maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production

line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of the various machines, affiliated equipment, and consumables is reported beforehand.

2. The maintenance notification system described in Claim 1 characterized by the fact that the cumulative operation value of each machine is the length obtained by adding up the passage lengths of the rolling material that has passed through the machine portion of the transport schedule.

3. A maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of each of the various machines, affiliated equipment, and consumables is obtained; the gap duration near the time is calculated; on the other hand, the maintenance time for the machine, affiliated equipment or consumable item as the target of maintenance is retrieved from a table; the maintenance time and the aforementioned gap duration are compared with each other, and judgment is made whether the maintenance should be performed in the gap duration while the line operates.

4. The maintenance notification system described in Claim 3 characterized by the fact that the machines, affiliated equipment, or consumables as targets of maintenance refer to at least two machines, items of affiliated equipment, or consumables having maintenance times near each other.

5. A maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of each of the various machines, affiliated equipment, and consumables is obtained; the predicted downtime of the production line near that time is compared with the maintenance time, and judgment is made whether maintenance of the machines, affiliated equipment, or consumables as the target of maintenance will be performed during said downtime.

6. The maintenance notification system described in Claim 1 characterized by the fact that when the affiliated equipment of the continuous production line of the iron and steel plant is a magnetic disk device, the cumulative operation value is the sum of the number of access cycles of the disk head during the period from the last replacement to the start of the prediction, and the number of the predicted access cycles after the prediction start time based on the transport schedule.

7. The maintenance notification system described in Claim 1 characterized by the fact that when the consumable item of the continuous production line of the iron and steel plant comprises the paper sheets of a typewriter, the cumulative operation value is the sum of the number of paper sheets used in the period from the last replacement to the start of the prediction and the number of paper sheets predicted to be needed after the prediction start time based on the transport schedule.

8. The maintenance notification system described in Claim 1 characterized by the fact that when the consumable item of the continuous production line of the iron and steel plant is the typewriter ribbon, the cumulative operation value is the sum of the number of printed characters during the period from the last replacement to the start of the prediction, and the number of characters predicted to be printed from the prediction start time based on the transport schedule.

Detailed explanation of the invention

[0001]

Technical field of the invention

This invention pertains to a maintenance notification system for optimizing the timing for maintenance of the continuous production line in an iron and steel plant.

[0002]

Prior art

As shown in Figure 13, in a conventional continuous production line, such as an iron and steel hot rolling line, material to be rolled (1a) or (1b), as the workpiece, is extracted from heating oven (2), and is rolled by primary rolls (3) and finish rolls (4). The rolled material is then wound up by coiler (5) to form the product. In this process, roll wear occurs for primary rolls (3) and finish rolls (4) over time, and this affects the quality of the product. Consequently, a certain standard is defined, and, when the amount rolled exceeds the standard, the rolls are changed. This operational standard is in units of tons of production output, and it is determined on the basis of the number of the material bars rolled.

[0003]

As shown in the flow chart in Figure 14, the standard rolling amount in tons before changing the rolls is obtained from a table. On the other hand, the cumulative amount of rolled material, in tons, is calculated. The two values are compared with each other. If the cumulative rolled amount in tons exceeds the standard rolling amount in tons, notification is made to change the rolls, so that the operator can prepare to perform the change. At an appropriate time, the operator shuts down the line and performs the change operation.

[0004]

Problems to be solved by the invention

In the aforementioned prior art, the time for changing the rolls is judged from the standard value and the cumulative rolled amount in tons, and the change operation is performed based on operator judgment using the roughly estimated change time. Consequently, when judgment errors occur, damage to machines and degradation of product quality result. This is undesirable.

[0005]

The purpose of this invention is to solve the aforementioned problems of the conventional methods by providing a maintenance notification system characterized by the following facts: on the basis of the manufacturing schedule, the rolling schedule is determined, and the transport schedule is derived; then, the cumulative rolling length for each roll is calculated and compared with the standard rolling length [before] change; and a correct prediction is made as to which roll or machine on the rolling line should be made the target of change.

[0006]

Means to solve the problems

This invention provides a maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of the various machines, affiliated equipment, and consumables is reported beforehand.

[0007]

In the aforementioned constitution, the cumulative operation value for each machine is the length obtained by adding up the passage lengths of the rolling material that has passed through the machine portion of the transport schedule.

[0008]

Also, this invention provides a maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of each of the various machines, affiliated equipment, and consumables is obtained; the gap duration near that time is calculated; on the other hand, the maintenance time for the machine, affiliated equipment or consumable item as the target of maintenance is retrieved from a table; the maintenance time and the aforementioned gap duration are compared with each other, and judgment is made whether maintenance should be performed in the gap duration while the line operates.

[0009]

In the aforementioned constitution, the machines, affiliated equipment, or consumables as targets of maintenance refer to at least two machines, affiliated equipment items, or consumables having maintenance times near each other.

[0010]

Also, this invention provides a maintenance notification system characterized by the following facts: in this maintenance notification system, the transport schedule of the continuous production line in an iron and steel plant is derived from the manufacturing schedule of the continuous production line; based on the aforementioned transport schedule, the cumulative operation values of the various machines, various affiliated equipment, and various consumables are calculated and predicted; by comparing the predicted value with a standard value, the time for maintenance (including replacement) of each of the various machines, affiliated equipment, and consumables is obtained; the predicted downtime of the production line near that time is compared with the maintenance time, and judgment is made whether maintenance of the machines, affiliated equipment, or consumables as the targets of maintenance will be performed during said downtime.

[0011]

When the affiliated equipment of the continuous production line of the iron and steel plant is a magnetic disk device, the cumulative operation value is the sum of the number of access cycles of the disk head in the period from the last replacement to the start of the prediction, and the number of predicted access cycles after the prediction start time based on the transport schedule.

[0012]

When the consumable item of the continuous production line of the iron and steel plant comprises the paper sheets of a typewriter, the cumulative operation value is the sum of the number of paper sheets used in the period from the last replacement to the start of the prediction, and the number of the paper sheets predicted to be needed after the prediction start time based on the transport schedule.

[0013]

Also, when the consumable item of the continuous production line of the iron and steel plant is the typewriter ribbon, the cumulative operation value is the sum of the number of printed characters during the period from the last replacement to the start of the prediction, and the number of characters predicted to be printed from the prediction start time based on the transport schedule.

[0014]

Operation

In the maintenance notification system of this invention, a transport schedule is prepared from the production schedule, the cumulative amount of rolled material passing each roll, machine, etc. is calculated and compared with a prescribed standard cumulative value so as to correctly predict the maintenance time for the rolls, machines, etc. Also, in order to perform the maintenance with higher efficiency, judgment is made as to whether maintenance can be made on-line, and whether maintenance can be made at the same time for several machines that have maintenance times near each other.

[0015]

Embodiments of the invention

Application Example 1

In the following, Application Example 1 of this invention will be explained with reference to figures. In Figure 1, (41) represents a computer that formulates the manufacturing schedule; (42) represents a maintenance notification device, which has rolling schedule calculating function (49), transport schedule calculating function (48), and maintenance control function (47). (43) represents a magnetic disk device that stores the data used by maintenance notification device (42). (44) represents a typewriter device that records the data output by maintenance notification device (42). (45) represents a disk controller that controls said magnetic disk device (43). (46) represents a typewriter controller that controls said typewriter device (44).

[0016]

In the following, its operation will be explained with reference to the flow chart shown in Figure 2. Based on the manufacturing schedule derived by manufacturing schedule computer (41), the rolling schedule is derived by rolling schedule calculating function (49) of maintenance notification device (42). From the data concerning size and speed obtained in this way, the transport schedule shown in Figure 3 is formed in N pieces. Figure 3 is a diagram illustrating the transport schedule from heating oven F'CE to winding by down coiler DC. Following the times of this transport schedule, the movement times of the tip and tail are predicted. As can be seen from Figure 3, when the movement time until rolling of N more pieces of the rolled material is predicted, rolling length S_{LR} of the R stand roll is $S_{LR} = l_{t01} + l_{t02} + \ldots + l_{tn3}$. This value is compared with a prescribed standard value S_{LR0}. If the value is larger than the standard value, the roll is taken as the target for change, and the time when this length has passed is reported as the change time. At the same time, the No. of the target rolled material is reported.

[0017]

For example, l_{t01} in Figure 3 becomes the rolling length performed by primary roller R roll for the first material rolled. This is added for each piece of rolled material, and it is compared with standard rolled length S_{LR0}. If the length is not greater than the standard rolling length, the rolling length of the next rolled material is calculated. This is then performed continuously. When the cumulative value is greater than the standard rolling length S_{LR0}, the time when the rolled material has passed is reported as the change time. Also, the No. of the rolled material is reported. These control operations are performed using maintenance control function (47). When it is determined that the roller, roll, or the like is to be changed, the production line is shut down to perform the change operation.

[0018]

Application Example 2

In Application Example 1, changing the roller, roll, etc. is performed after the production line is shut down. In Application Example 2, however, the change is performed without shutting down the production line. Now, as shown in Figure 4, in the rolling schedule for N + 1 rolled materials, when the Nth machine is to be changed, before change time P, the gap duration τ_{GAP} at the position of the machine to be changed (such as R stand roll) is calculated. Also, at the same time, for a machine for which change time τ_C is prescribed, said τ_C is retrieved from the maintenance table shown in Figure 6, and it is compared with τ_{GAP}. If $\tau_C < \tau_{GAP}$, it is judged that it is possible to perform a so-called on-line change, that is, a change during the gap duration, and the on-line change operation is performed. The flow chart in this case is shown in Figure 5.

[0019]

Application Example 3

In cases where plural machines are to be changed, a state different from that shown in Application Example 1, judgment is made whether they can be changed at the same time. If they can be changed at the same time, the change operation can be performed with higher efficiency. First of all, as shown in Figure 7(A), the change times of the various machines, t_{CM1}, t_{CM2}, ... t_{CMN} are calculated and they are set side by side in order of proximity to the present time, as shown in Figure 7(B). These times are labeled as t_{C1}, t_{C2}, ... t_{CN}. Then, as the differences between adjacent times, $\Delta t_{C1} = t_{C2} - t_{C1}$, $\Delta t_{C2} = t_{C3} - t_{C2}$,... If Δt_{Ci} is small, it is possible to perform the change for these two machines at the same time. For example, as shown in Figure 7(B), if Δt_{C5} is small, it means $t_{CM6} - t_{CM5}$ is small, so that machine M_4 and machine M_6 can be changed at the same time in the on-line mode. The values of Δt_{C4}, Δt_{C3}, Δt_{C2}, and Δt_{C1} are surveyed sequentially and judgment is made whether the machines can be changed at the same time. The flow chart is shown in Figure 8.

[0020]

Application Example 4

In Application Examples 1-3, the change time for the machine is predicted from the transport prediction. However, when the downtime of the production line is known beforehand, it is possible to control whether a machine change is to be performed within the downtime of the production line by simply adding the flow chart shown in Figure 9. The predicted outage time is taken as the period T_X to T_Y, and the extraction time for the last rolled material extracted before the predicted downtime is taken as T_Z. Then, the extraction pitch ΔT_{Z+1} of the rolled material to

be extracted next after T_Z is calculated. $T_Y - T_X$ is compared with ΔT_{Z+1}. If $T_Y - T_X > \Delta T_{Z+1}$, the predicted downtime is used to perform the change operation. If not, the production line is shut down at the predicted change time to perform the change operation. In this application example, it is possible by shutting down the production line to reduce the number of maintenance operation cycles.

[0021]

Application Example 5

In Application Examples 1-4, the object of maintenance has been machines on the production line. However, it is also possible to take disk device (43), a device affiliated with the maintenance notification device shown in Figure 1, as the target of maintenance. Figure 10 is a flow chart illustrating the operation. First of all, based on the transport schedule, the cumulative number of access cycles is predicted from the predicted disk access cycle numbers of the various rolled materials at various positions. Then, the access cycle number N_{EH} of the head from the prediction start time is predicted. Then, the tolerance value N_{OH} of the access cycle number of the disk head is extracted from the table. After that, the actual access cycle number N_{MH} of actual disk accessions by the head from the time the head was changed to the start time of the maintenance control function ($N_{MH} = 0$ may take place) is derived. In this case, when $N_{EH} + N_{MH} > N_{OH}$, the change time of the disk device is derived, and it is displayed and reported. On the other hand, when the aforementioned relationship is not established, disk device change is not performed.

[0022]

Application Example 6

Similarly, it is possible to predict the replacement time for the typewriter device (44) sheets of paper by adding the flow chart shown in Figure 11. First of all, on the basis of the transport schedule, the cumulative number of printed paper sheets is predicted from the number of paper sheets to be printed for the various rolled materials at various positions. Then, from the predicted number of printed paper sheets, the number of paper sheets needed N_{EP} is calculated and predicted. Then, the limit number of paper sheets N_{OP} is extracted from the table of limit values for paper sheets. Then, the actual number of paper sheets N_{MP} that have been used from the time the paper sheets were changed to the time of start of the maintenance control function is read by a counter. In this case, when $N_{EP} + N_{MP} > N_{OP}$, the time to replace the paper sheets is derived, displayed, and reported. On the other hand, when the aforementioned relationship is not established, replacement of paper sheets is not performed.

[0023]

Application Example 7

Similarly, it is possible to predict the change time for the ribbon of typewriter device (44) by adding the flow chart shown in Figure 12. First of all, on the basis of the transport schedule, the cumulative number of characters printed is predicted from the numbers of characters to be printed for the various rolled materials at various positions. Then, number N_E of the characters to be printed in the printing operation is calculated and predicted. Then, from the table of character number tolerance values for the ribbon, the limit number of characters N_O is extracted. Then, the actual number of characters N_M that have been printed from the time the ribbon was changed to the start time of the maintenance control function is read by a counter. In this case, when $N_E + N_M > N_O$, the change time for the ribbon is derived, displayed, and reported. On the other hand, when the aforementioned relationship is not established, the ribbon change is not performed.

[0024]

Effects of the invention

According to this invention, the cumulative operation value is derived from the transport schedule of the production line, and it is possible to more correctly predict which machine, etc. is to become the target of maintenance, and what the necessary time of maintenance will be.

[0025]

Also, by means of judgment whether the maintenance operation can be performed on-line, or, as needed, whether plural machines, etc. can be maintained at the same time, it is possible to perform maintenance more effectively.

[0026]

Also, in the maintenance of affiliated devices and consumables of the production line, the cumulative operation value is determined on the basis of the actual value and the predicted value, and, on the basis of such a cumulative operation value, the maintenance time is predicted, so that the maintenance time can be predicted more correctly.

Brief description of the figures

Figure 1 is a block diagram illustrating the maintenance notification system in Application Example 1 of this invention.

Figure 2 is a flow chart illustrating the operation of Application Example 1.

Figure 3 is a diagram of the transport schedule illustrating the operation in Application Example 1.

Figure 4 is a diagram of the transport schedule illustrating the operation in Application Example 2.

Figure 5 is a flow chart illustrating the operation in Application Example 2.

Figure 6 is a diagram illustrating an example of the maintenance table.

Figure 7 is a diagram of the predicted maintenance time illustrating the operation in Application Example 3.

Figure 8 is a flow chart illustrating the operation in Application Example 3.

Figure 9 is a flow chart illustrating the operation in Application Example 4.

Figure 10 is a flow chart illustrating the operation in Application Example 5.

Figure 11 is a flow chart illustrating the operation in Application Example 6.

Figure 12 is a flow chart illustrating the operation in Application Example 7.

Figure 13 is a schematic diagram illustrating the hot rolling line.

Figure 14 is a flow chart illustrating operation of the conventional maintenance notification system.

Explanation of symbols

1a, 1b	Material to be rolled
2	Heating oven
3	Primary rolling roll
4	Finish rolling roll
5	Coiler
41	Manufacturing schedule computer
42	Maintenance notification device
43	Magnetic disk device
44	Typewriter device
45	Magnetic disk controller
46	Typewriter controller
47	Maintenance control function
48	Transport schedule calculating function
49	Rolling schedule calculating function

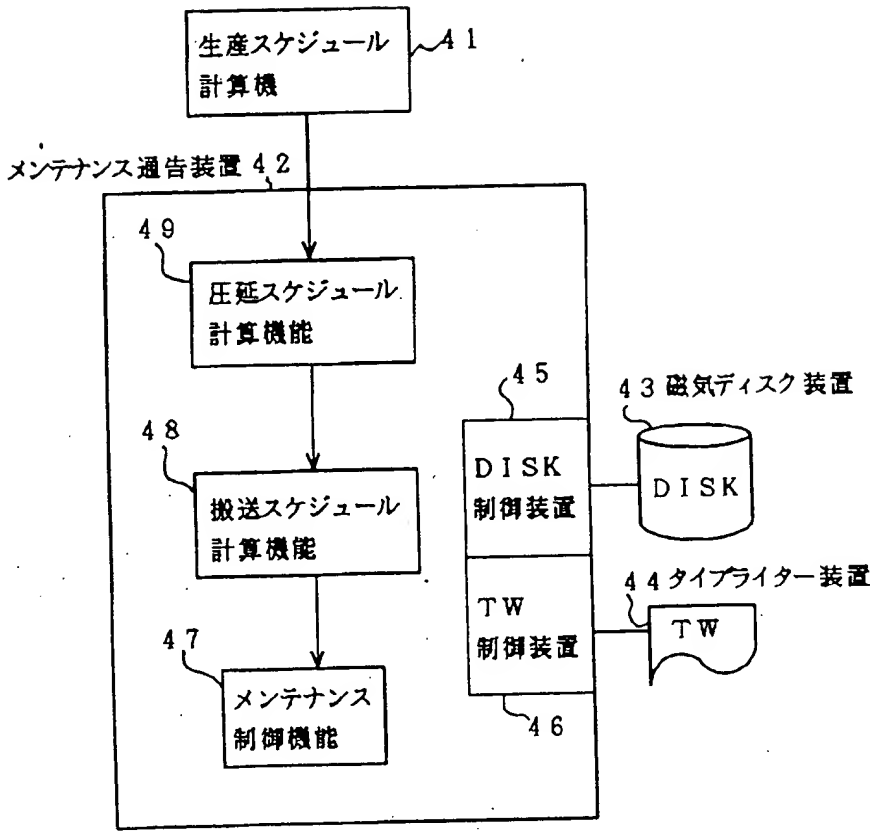


Figure 1

Key:
41 Manufacturing schedule computer
42 Maintenance notification device
43 Magnetic tape device
44 Typewriter device
45 DISK controller
46 TW [Typewriter] controller
47 Maintenance control function
48 Transport schedule computing function
49 Rolling schedule computing function

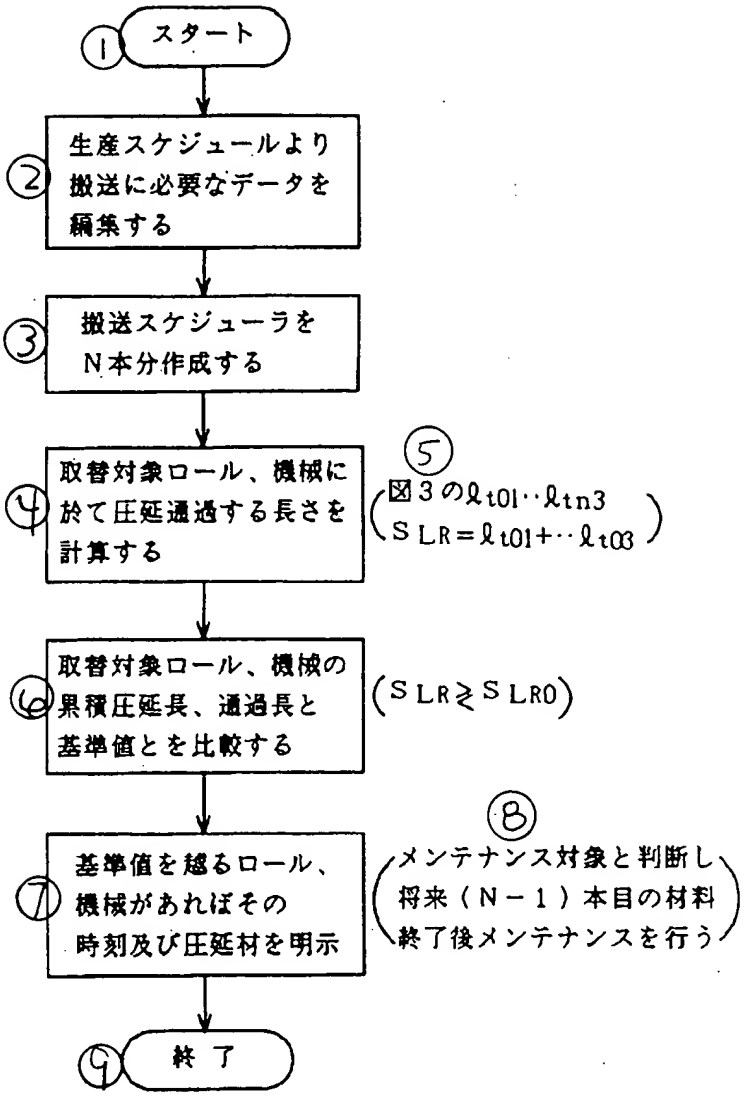


Figure 2

Key:
1 Start
2 Editing data needed for transport by means of the manufacturing schedule
3 Preparation of the transport schedule in N pieces
4 Calculation of rolling passage length for the rolls and machines as target of change
5 In Figure 3
6 Comparison of the cumulative rolling length and passage length of the rolls and machines targeted for change with the standard value
7 If there is a roll or machine with a value over the standard value, the time and amount of rolled material are displayed
8 (Judgment of the target of maintenance is made, and maintenance is performed after completion of processing of the future (N-1)th material
9 End

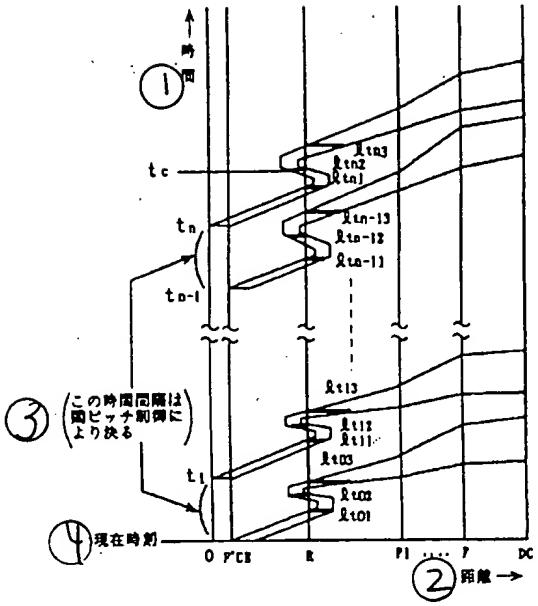


Figure 3

Key:
1 Time
2 Distance
3 (This time interval is determined by the gap duration control)
4 Present time

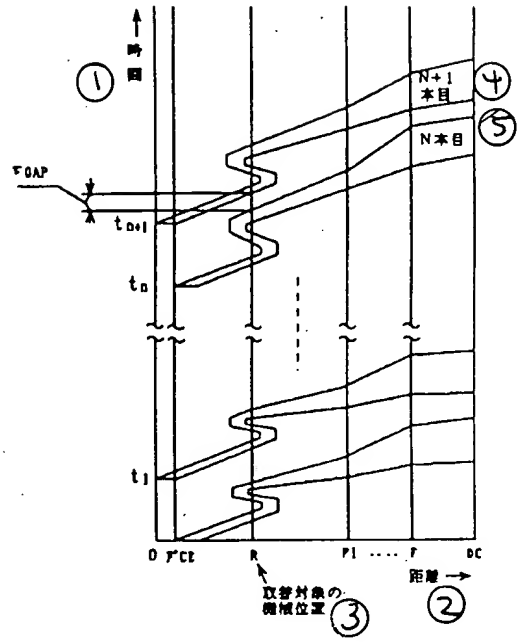


Figure 4

Key:
1 Time
2 Distance
3 Mechanical position of the target of change
4 (N+1)th piece
5 Nth piece

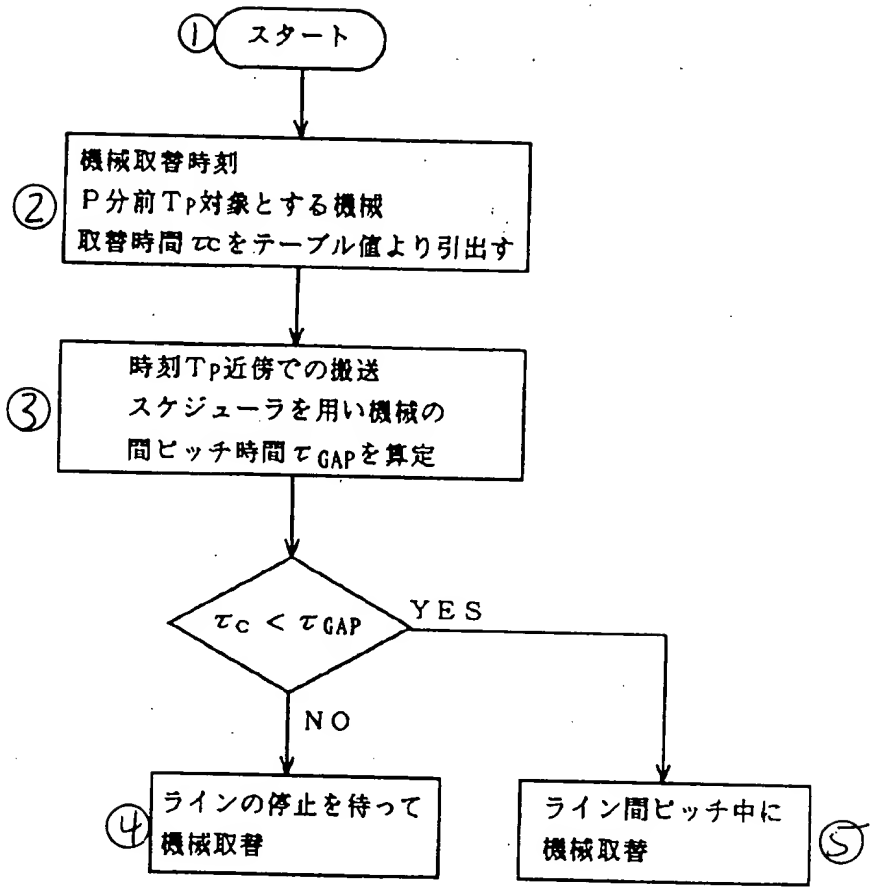


Figure 5

Key:
1 Start
2 Machine replacement time
Replacement time τ_C of the machine as Tp object of P pieces ago is extracted from the table
3 Gap duration time τ_{GAP} of the machine is calculated using the transport schedule near time Tp
4 Machine is changed when the line is shut off
5 Machine is changed during the gap duration on the line

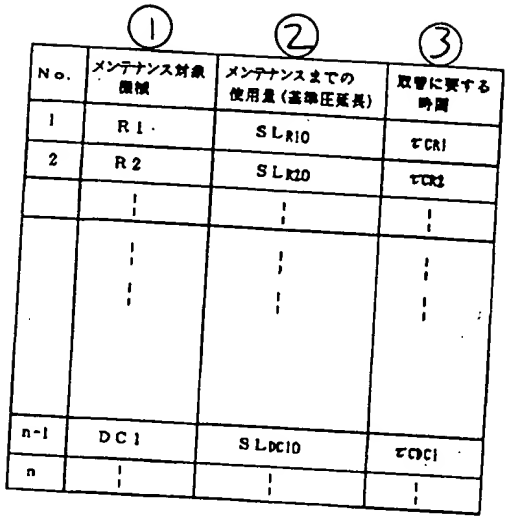


Figure 6

Key: 1 Machine as target of maintenance
2 Amount used until maintenance (standard rolling length)
3 Time required for change

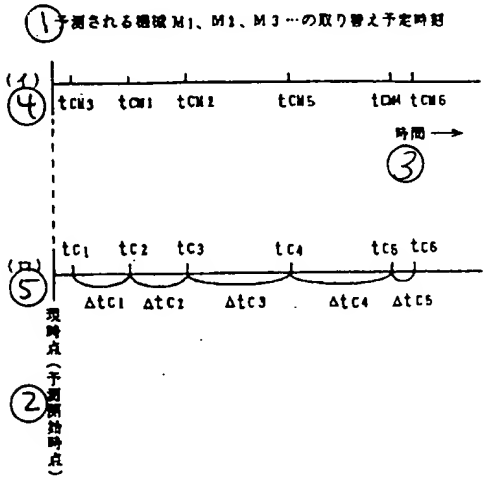


Figure 7

Key: 1 Predicted change times for predicted machines M1, M2, M3...
2 Present time (predicted start time)
3 Time
4 A
5 B

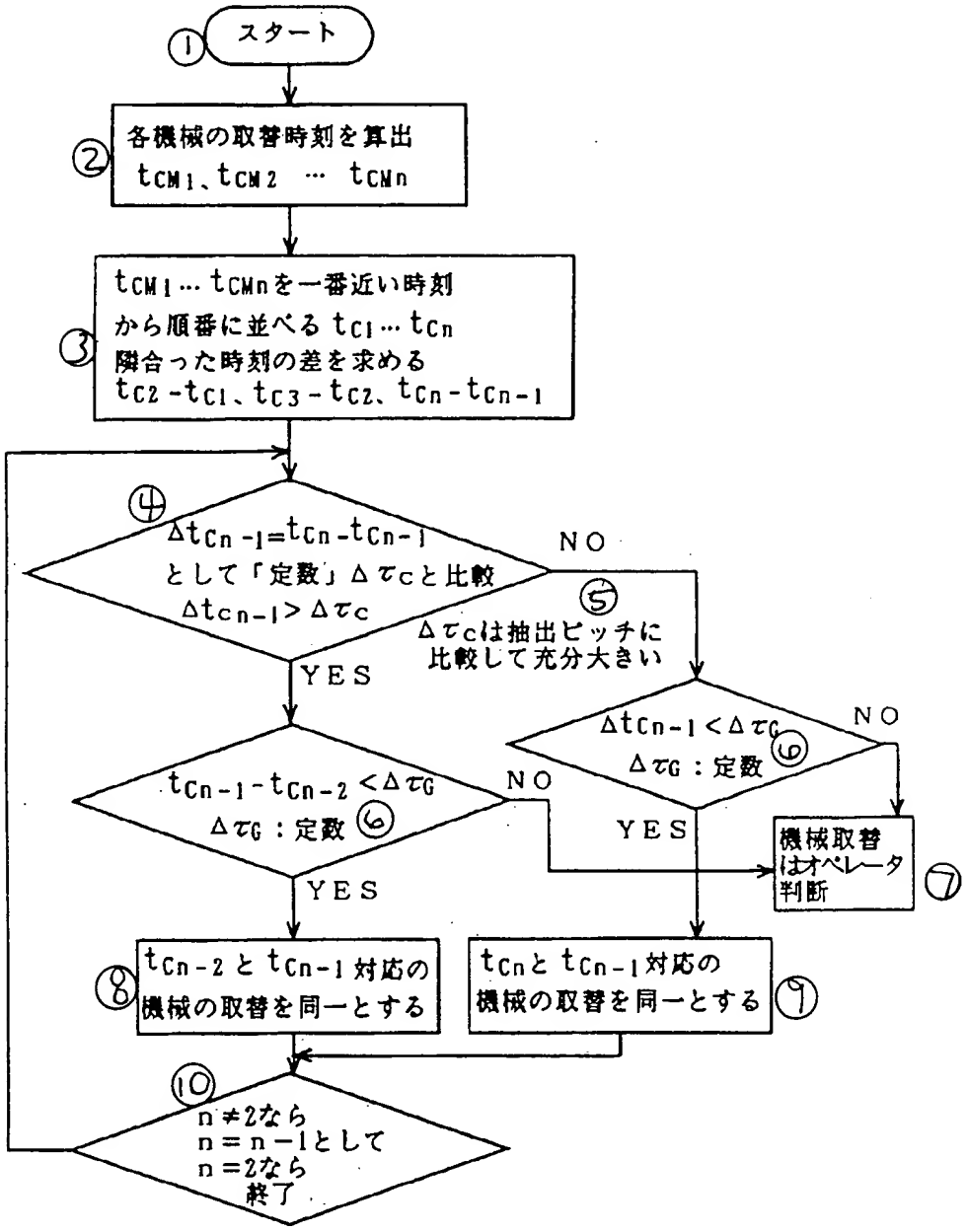


Figure 8

Key:
1 Start
2 Calculation of change times for various machines
t_{CM1}, t_{CM2} … t_{CMn}
3 t_{CM1}, … t_{CMn} are calculated and they are set side by side in order of proximity to the time, and the differences in the adjacent times t_{C1}…t_{Cn} are derived
t_{C2}-t_{C1}, t_{C3}-t_{C2}, t_{Cn}-t_{Cn-1}
4 Comparison is made between $\Delta t_{Cn-1} = t_{Cn} - t_{Cn-1}$
$\Delta t_{Cn-1} > \Delta \tau_C$
5 $\Delta \tau_C$ is compared with the extracted gap duration and is sufficiently large
6 $\Delta t_{Cn-1} < \Delta \tau_G$

$\Delta\tau_G$: Constant

7 Machine change is judged by the operator

8 Change of the machine corresponding to t_{Cn-2} and that corresponding to t_{Cn-1} are taken as identical to each other

9 Change of the machine corresponding to t_{Cn} and that corresponding to t_{Cn-1} are taken as identical to each other

10 If n γ 2, it is set as n = n-1; if n = 2, End

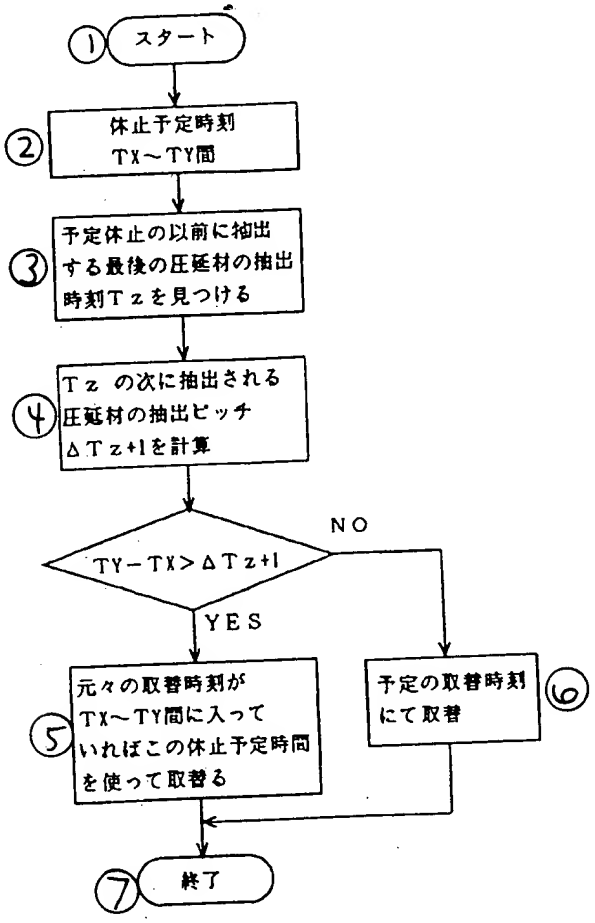


Figure 9

Key: 1 Start

2 Predicted downtime: between T_X to T_Y

3 Extraction time T_Z of the last rolled material extracted before the predicted pause is determined

4 Extraction pitch ΔT_{Z+1} of the rolled material extracted after T_Z is calculated

5 When the original change time fits within the period T_X to T_Y, this predicted downtime is used for the change

6 Change at the predicted change time

7 End

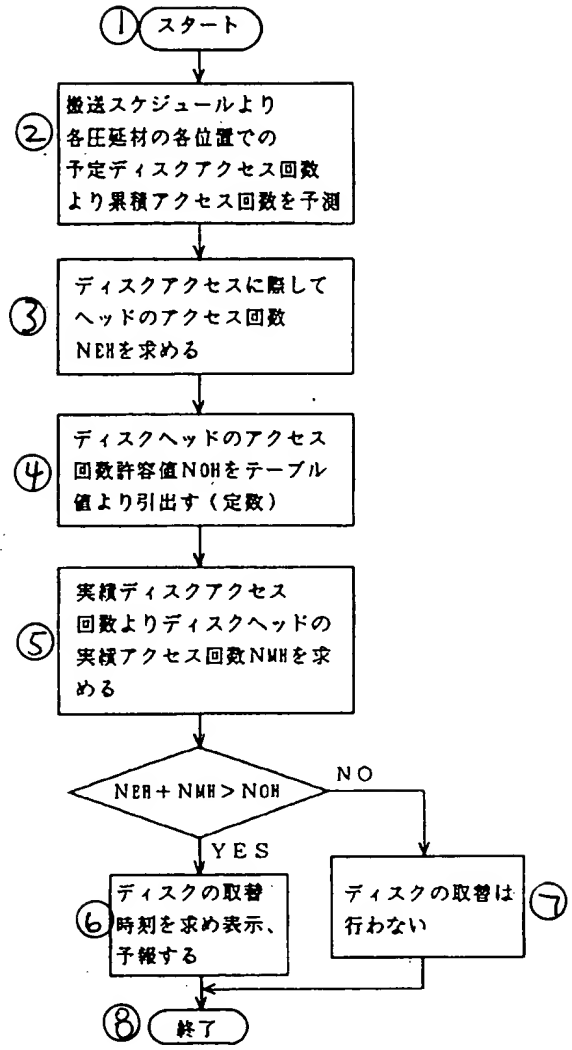


Figure 10

Key:
1 Start
2 Cumulative access cycle number is predicted from the predicted disk access cycle number for the various rolled materials at the various positions according to the transport schedule
3 Access cycle number N_{EH} for the head is derived during disk access
4 Tolerance value N_{OH} of the disk head access cycle number is extracted from the table (a constant)
5 Actual disk head access number N_{MH} is derived from the actual disk access cycle number
6 Disk change time is derived, displayed and reported
7 Disk change is not performed
8 End

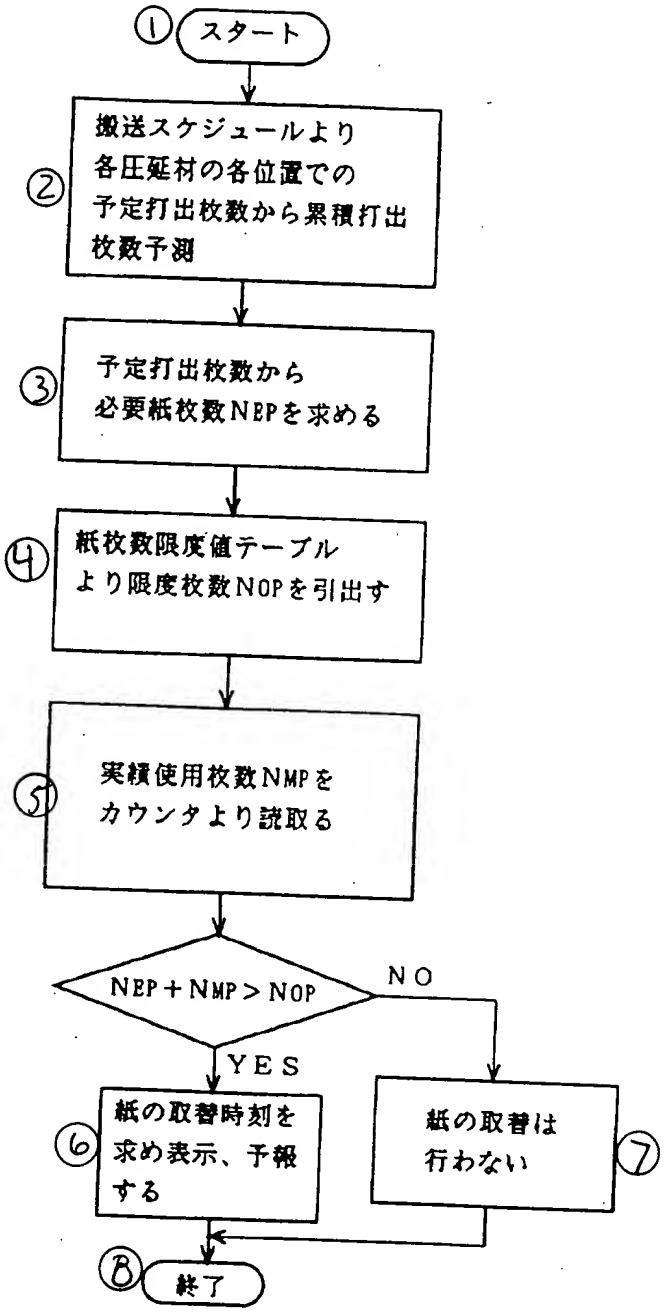


Figure 11

Key: 1 Start
2 Cumulative printed sheet number is predicted from the predicted printed sheet number for the various rolled materials at the various positions according to the transport schedule
3 Necessary paper sheet number N_{EP} is derived from the predicted printed sheet number
4 Limit number N_{OP} is extracted from the table of paper sheet limit values
5 Actual number of sheets used N_{MP} is read by a counter

6 Replacement time for paper sheets is derived, displayed and reported
7 Paper sheet replacement is not performed
8 End

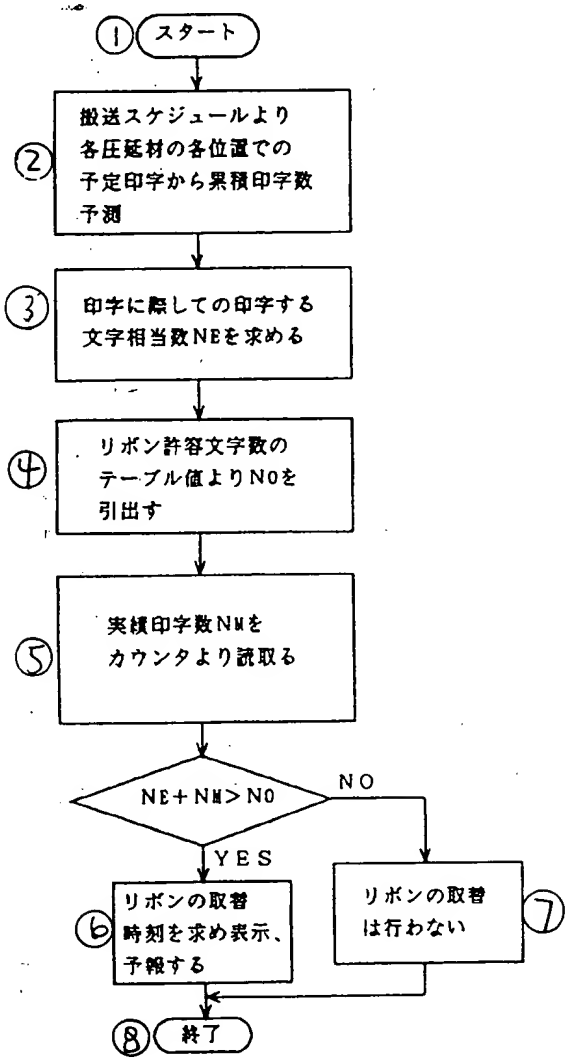


Figure 12

Key: 1 Start
2 Cumulative printed character number is predicted from the predicted printed character number for the various rolled materials at the various positions according to the transport schedule
3 Number N_E corresponding to the printed characters during printing operation is derived
4 Number N_O is extracted from the table of tolerance character number for the ribbon
5 Actual printed character number N_M is read by a counter
6 Change time for ribbon is derived, displayed and reported

7 Ribbon change is not performed
8 End

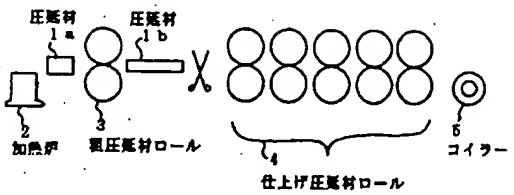


Figure 13

Key: 1a, 1b Material to be rolled
2 Heating oven
3 Primary rolling roll
4 Finish rolling roll
5 Coiler

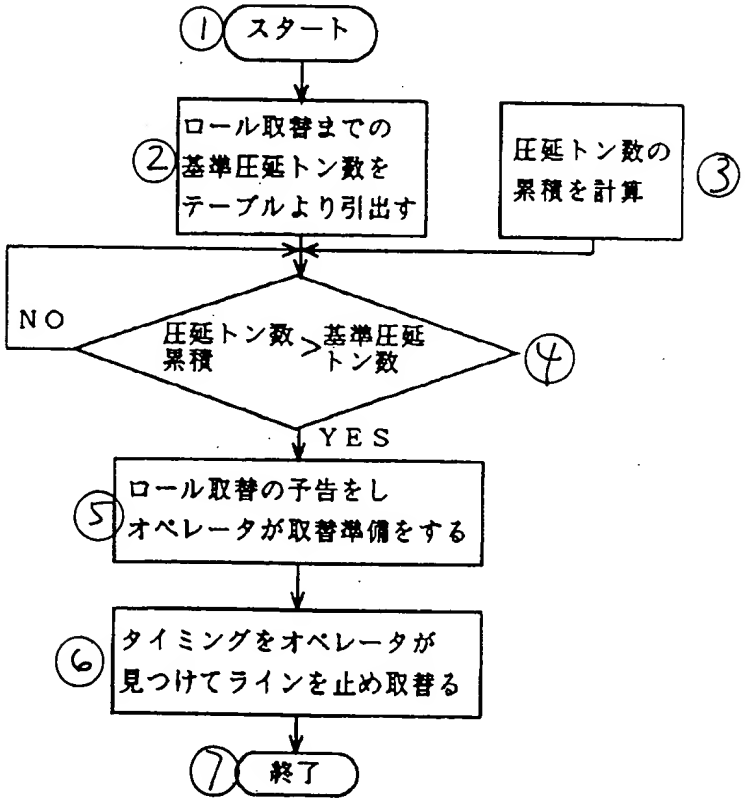


Figure 14

Key: 1 Start
2 Standard rolling amount in tons until change of the roll is extracted from the table
3 Cumulative rolling amount in tons is calculated

4 Cumulative rolling amount in tons > standard rolling amount in tons
5 Prediction of roll change is made, and the operator prepares for change
6 The operator watches the timing, shuts down the line, and makes the change
7 End